

***IN THE DRAWINGS***

Please amend the drawings by substituting the enclosed 6 sheets of drawings containing FIGS. 1, 2, 3a, 3b, 4a, and 4b for the 6 sheets of drawings containing the same figures previously submitted on June 13, 2004.

The drawings are hereby amended to remove the labels of “WO/060821” and “PCT/EP02/14002.” These labels are being removed to avoid any obscuring of the fact that this patent application is an application for a U.S. Patent.

## ***REMARKS***

Claims 11-20 were pending in this application. Claims 11-20 were rejected in the office action dated June 29, 2007.

Claims 11-18, and 20 are hereby amended to more specifically recite inherent aspects of the invention as originally claimed, and to overcome the rejections based on 35 U.S.C. § 101, and 35 U.S.C. § 112. Claim 19 is hereby cancelled. No amendment in the claims is made to overcome any cited references.

Based on the above Amendment and the following Remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections, and withdraw them.

### ***Information Disclosure Statement***

Note is taken as to the statement in the Office Action that references appearing on pages 3, and 15-16 of the specification were not submitted for consideration by the Patent Office. The references appearing on pages 3, and 15-16 of the specification are: (1) Dasgupta et al., "Evolutionary Algorithm in Engineering Applications" (Springer-Verlag, 1997), (2) Miettinen et al., "Evolutionary Algorithms in Engineering and Computer Science," John Wiley and Sons (1997), (3) D.A. Veldheizen et al. "Multi-Objective Evolutionary Algorithms: Analyzing the State of the Art," Evolutionary Computation, 8(2), pp. 125-147 (2000), and (4) Cvetkovic et al.,

“Use of Preferences for GA-based Multi-Objective Optimization,” Proceedings of 1999 Genetic and Evolutionary Computation Conference, pp. 1504-1510, 1999. These four references were previously submitted in part or in their entirety in the information disclosure statement dated May 31, 2005. Specifically, reference C4 of the information disclosure statement dated May 31, 2005 (Dasgupta, D. et al., “Evolutionary Algorithms – An Overview”) is chapter 1 of Dasgupta et al., “Evolutionary Algorithm in Engineering Applications” (Springer-Verlag, 1997). Also, reference C5 of the information disclosure statement dated May 31, 2005 (Deb, K, “Evolutionary Algorithm for Multi-Criterion Optimization in Engineering Design”) is chapter 8 of Miettinen et al., “Evolutionary Algorithms in Engineering and Computer Science” (John Wiley and Sons, 1997). D.A. Veldheizen et al. “Multi-Objective Evolutionary Algorithms: Analyzing the State of the Art,” Evolutionary Computation, 8(2), pp. 125-147 (2000), and Cvetkovic et al., “Use of Preferences for GA-based Multi-Objective Optimization,” Proceedings of 1999 Genetic and Evolutionary Computation Conference, pp. 1504-1105, 1999 were previously submitted as reference C11 and C3 in the information disclosure statement dated May 31, 2005, respectively. Therefore, all of the reference described on pages 3, and 15-16 of the specification were submitted in the information disclosure statement dated May 31, 2005.

### ***Objection to the Specification***

On page 1 of the Office Action, the specification was objected to for including labels “WO 03/060821” and “PCT/EP02/14002” on the top of all pages. This rejection is overcome in view of the amendment to the specification. A substitute specification is hereby submitted

removing these labels. A specification marked to show all changes relative to the immediately prior version of the specification of record is also submitted herewith. Therefore, the Examiner is respectfully requested to withdraw this objection.

### ***Objection to the Drawings***

On pages 1 and 2 of the Office Action, the drawings were objected to for including the labels “WO 03/060821” and “PCT/EP02/14002” on the top of all pages. This objection is overcome in view of amendment to the drawings. Replacement sheets of drawings are hereby submitted removing these labels. Therefore, the Examiner is respectfully requested to withdraw this objection.

### ***Claim Objections***

On page 4 of the Office Action, claims 13 and 20 were objected to for including informalities. Specifically, claim 13 was objected to because the phrase “letting the parameters take all the allowed value” does not make grammatical sense. Claim 20 was objected to because it was not in an independent claim format. These objections are overcome in view of the amendment to claims 13 and 20.

Claim 13 is hereby amended to delete the phrase “letting the parameters take all the allowed value.” Therefore, claim 13 no longer includes any grammatical errors. Claim 20 is hereby amended to a dependent claim which does not refer to any other claims. Therefore, the Examiner is respectfully requested to withdraw these objections.

***Rejection of Claims under 35 U.S.C. § 101***

On page 4 of the Office Action, claims 11 to 20 were rejected under 35 U.S.C. § 101 for being directed to non-statutory subject matter. Specifically, it is stated in the Office Action that claims 11 to 20 fail to set forth a practical application of the judicially created exception to produce a real-world result. This rejection is respectfully traversed in view of the amendment to the claims.

Claim 11 is hereby amended to recite “A method for multi-objective optimization of a mechanical, aerodynamic or hydrodynamic body.” Furthermore, claim 11, as amended, specifically recites the step of “outputting one or more offspring individuals . . . as the optimized object parameters of the mechanical, aerodynamic or hydrodynamic body.” Therefore, the claimed invention of claim 11 clearly states that the practical application is to optimize the mechanical, aerodynamic or hydrodynamic body.

The patentability guidelines beginning on page 2100-8 of the August 2006 revision of the MPEP, set forth a variety of guidelines for determining patentability. Applicants note that these

guidelines are not law and must be interpreted in a manner consistent with the statutes and case law in this area. Applicants reserve the right to dispute the validity of these guidelines. However, even based upon the guidelines Applicants believe that the claims recite statutory subject matter. In particular, on page 2100-11, section 2 applies to “claims including such excluded subject matter” where the excluded subject matter includes abstract ideas, laws of nature or natural phenomenon. Applicants submit that claim 11 does not fall into this category since this claim is not directed to any of these three categories, in particular there is no “abstract idea” in optimizing a mechanical, aerodynamic or hydrodynamic body. The mechanical, aerodynamic or hydrodynamic body is a specific object having tangible properties (e.g., dimensions). For this reason, Applicants believe that claim 11 recites statutory subject matter.

In addition, even if section 2 is applied, the pending claims satisfy the carve-out provisional defined by subsection (2) on page 2100-11 applies because the claims produce a useful, concrete and tangible result. In the guidelines, a claim recites statutory subject matter if the “result achieved by the claimed invention is ‘useful, tangible, and concrete.’” See MPEP, page 2100-12. The results of the claims are optimized parameter set of a mechanical, aerodynamic or hydrodynamic body. (1) This result satisfies the useful result prong of the guidelines because the results of the claims, i.e., the offspring individuals representing the mechanical, aerodynamic or hydrodynamic body, can be used to produce corresponding mechanical, aerodynamic or hydrodynamic structures. (2) The tangible result section states that “the tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing. However, . . . the process claim must set forth a practicable application . . . to produce

a real-world result.” The claimed invention produces a real-world result, i.e., the optimized mechanical, aerodynamic or hydrodynamic body. Therefore, the claimed invention meets the tangible result prong of the guideline. (3) The concrete result prong is defined in the MPEP as meaning that the results must be substantially repeatable, i.e., that the results are not unrepeatable or unpredictable. The steps of claim 11 are concrete and repeatable; and there is no indication that the Examiner contends otherwise.

Accordingly, it is respectfully submitted that claim 11, as amended, is directed to statutory subject matter. Claims 12-18 are dependent from claim 11; and thus claims 12-18 are also directed to statutory subject matter. Claim 19 is cancelled herein; and thus, rejection of claim 19 is now moot.

Claim 20, as amended, specifically recites “A computer product for multi-objective optimization of a mechanical, aerodynamic or hydrodynamic body” and “output one or more offspring individuals after the termination criterion is met as the optimized object parameters of the mechanical, aerodynamic or hydrodynamic body.” Therefore, essentially the same arguments set forth above for claim 11 are equally applicable to claim 20.

Accordingly, it is respectfully submitted that claims 11-18, and 20, as amended, are directed to statutory subject matter. Therefore, the Examiner is respectfully requested to withdraw this rejection.

***Rejection of Claims under 35 U.S.C. § 112, first paragraph – practical application***

On pages 5 and 6 of the Office Action, claims 11 to 20 were rejected under 35 U.S.C. § 112, first paragraph for having not disclosed the practical application for the invention, and as a matter of law there is no way applicants could have disclosed how to practice the undisclosed practical application. This rejection is respectfully traversed.

As set forth above with respect to the rejection under 35 U.S.C. § 101, claim 11 is hereby amended to recite “A method for multi-objective optimization of a mechanical, aerodynamic or hydrodynamic body” and “outputting one or more offspring individuals after the termination criterion is met as the optimized object parameters of the mechanical, aerodynamic or hydrodynamic body.” Therefore, claim 11, and its dependent claims 12-18, as amended, recite eligible subject matter under 35 U.S.C. § 101. Accordingly, the reason stated in the Office Action for rejecting claim 11 under 35 U.S.C. § 112, first paragraph, is no longer applicable.

Likewise, claim 20 is hereby amended to recite “A computer product for multi-objective optimization of a mechanical, aerodynamic or hydrodynamic body” and “output one or more offspring individuals after the termination criterion is met as the optimized object parameters of the mechanical, aerodynamic or hydrodynamic body.” Therefore, essentially the same arguments set forth above for claim 11 are equally applicable to claim 20.

Claim 19 is cancelled herein. Therefore, the rejection of claim 19 is now moot.



Accordingly, it is respectfully submitted that claims 11-18, and 20, as amended, are enabling under 35 U.S.C. § 112, first paragraph. Therefore, the Examiner is respectfully requested to withdraw this rejection.

***Rejection of Claims under 35 U.S.C. § 112, first paragraph – written description***

On page 6 of the Office Action, claims 11-20 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Specifically, claims 11 and 20 were rejected because no description or support was found in the specification for the limitation of “wherein weight intervals of different sub-functions have different values to reflect different priorities of the underlying objectives.” Claim 19 was rejected because the calculation of an outlet angle by a Navier-Stokes solver and geometric constraints were not described anywhere in the specification. Claims 12-18 were rejected for depending from a rejected base claim. This rejection is overcome in view of the amendment to claims 11 and 20.

Claims 11 and 20 are amended herein to no longer recite “wherein weight intervals of different sub-functions have different values to reflect different priorities of the underlying objectives.” Claims 11 and 20, therefore, no longer recite any elements not supported by the specification. Therefore, rejection of claims 11-18, and 20 is overcome in view of the amendment to claims 11 and 20. Claim 19 is hereby cancelled. Accordingly, rejection of claim 19 is now moot.

Therefore, the Examiner is respectfully requested to withdraw rejection of claims 11-18 and 20.

***Rejection of Claims under 35 U.S.C. § 112, first paragraph – enablement***

On pages 6 and 7 of the Office Action, claims 11-20 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Specifically, claims 11-20 were rejected because Applicant did not provide evidence for reducing the invention to practice any of the applications (e.g., preliminary turbine design, turbine blade design, multi-disciplinary rotor blade design, multi-disciplinary wing platform design, and military air-frame preliminary design) within the disclosure. It is stated in the Office Action that the Applicants suggested what the invention may be used for, but did not teach one of skill in the art how to do so. This rejection is respectfully traversed.

Applicants submit that claims 11-18 and 20 are enabling because the way of using an evolutionary algorithm for designing mechanical, aerodynamic or hydrodynamic bodies were well known in the art before the effective filing date of this patent application. For example, Oyama, A. et al., “Euler/Navier-Stokes Optimization of Supersonic Wing Design Based on Evolutionary Algorithm,” (1999) (“Oyama”) (cited in the Office Action) discloses one way of generating a supersonic wing design using one type of evolutionary algorithm. Although the claimed invention is patentably distinct from Oyama in the specific evolution algorithm used, Oyama, for example, discloses the method of converting design problems associated with

designing a mechanical, aerodynamic or hydrodynamic body into an optimization problem. See Oyama, chapter 2. After converting the design problem into the optimization problem, the specification specifically describes how the parameters of the mechanical, aerodynamic or hydrodynamic body can be evolved to obtain an optimized mechanical, aerodynamic or hydrodynamic body. Therefore, a person of ordinary skill in the art may make or use the claimed invention of claim 11 without undue experimentation.

The way of converting the design problem associated mechanical, aerodynamic or hydrodynamic bodies into an optimization problem was well known in the art before the effective filing date of this application. Therefore, a person of ordinary skill in the art may make or use the claimed invention of claims 11-18 and 20 without undue experiment. Accordingly, the Examiner is respectfully requested to withdraw this rejection.

***Rejection of Claims under 35 U.S.C. § 112, second paragraph***

On page 7 of the Office Action, claims 11-20 were rejected under 35 U.S.C. § 112, second paragraph, for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, claims 11 and 20 were rejected for reciting “priority” and “the weight intervals,” the meanings of which are unclear. Claim 13 was rejected because it was not clear how a parameter can simultaneously represent all the allowed values. Claim 17 was rejected because it was unclear how the weighting accomplishes any

purpose if all offspring in each generation have the same weight. Claim 19 was rejected for not clarifying the relationship between calculating an outlet angle by a Navier-Stokes solver can be accomplished by optimizing an aerodynamic or hydrodynamic body. This rejection is respectfully traversed in view of the amendment to claims.

Claim 11 is hereby amended to delete the limitation of “wherein weight intervals of different sub-functions have different values to reflect priorities of the underlying objectives.” Accordingly, claim 11, as amended, no longer recites “priority” or “weight intervals.” Therefore, claim 11, as amended, does not recite any limitations that are indefinite.

Claim 13 is hereby amended to delete the limitation of “letting the parameters take all the allowed value instead of assigning one specific value to each parameter” and instead recite “converting the preferences into parameterized values comprises assigning values within the first and second predetermined ranges to the parameterized values.” Therefore, claim 13 no longer recites that the parameters take all of the allowed values. Further, claim 13 is hereby amended to no longer recite the phrase “instead of.” Therefore, claim 13, as amended no longer recites any limitations that are indefinite.

Claim 17 is hereby amended to recite “each offspring is evaluated using the same weighted sub-functions in the same cycle.” Therefore, claim 17 no longer recites that the offspring have the same weight. Instead, claim 17, as amended, recites that the offspring individuals are *evaluated* using the same weighted sub-functions.

Claim 19 is hereby cancelled. Therefore, the rejection of claim 19 is now moot.

Claim 20 is hereby amended into an independent claim form. Claim 20, as amended, does not recite “wherein weight intervals of different sub-functions have different values to reflect different priorities of the underlying objectives.” Therefore, claim 20, as amended, no longer recites any limitations that are indefinite.

Claims 11, 13 and 17, and 20, are hereby amended to particularly point out and distinctly claim the subject matter. Therefore, the Examiner is respectfully requested to withdraw this rejection.

***Rejection of Claims under 35 U.S.C. § 103***

On page 8 of the Office Action, claims 11-18 and 20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Jin Y. et al., “Adapting Weighted Aggregation for Multiobjective Evolution Strategies,” 2001, pp. 86-110, Springer-Verlag (March, 2001) (“Jin”) in view of Fonseca, C. et al., “Multiobjective Optimization and Multiple Constraint Handling with Evolutionary Algorithms – Part I: A United Formation,” IEEE Transactions on Systems, Man, and Cybernetics – Part A: Systems and Humans, IEEE., vol. 28, No. 1, pp. 26-37, (January 1998) (“Fonseca”). This rejection is traversed in view of amendment to the claims.

Independent claim 11, as amended, specifically recites:

“(f) changing weights of the weighted sub-functions for the next cycle within predetermined ranges, a first weight of the weighted sub-functions changing within a first predetermined range, a second weight of the weighted sub-functions changing within a second predetermined range different from the first predetermined range, the first predetermined range and the second predetermined range representing preferences given to objectives of the multiple objective optimization . . . .”

In the claimed invention, the weights (e.g.,  $w_1^d(t)$  and  $w_2^d(t)$ ) are allowed to change within different ranges to indicate preferences given to different objectives. If the first weight  $w_1^d(t)$  has a higher predetermined range compared to the second weight  $w_2^d(t)$ , an objective associated with the first weight  $w_1^d(t)$  is given a higher priority compared to another objective associated with the second weight  $w_2^d(t)$ . For example, in the first preference illustrated on page 5, the first weight  $w_1^d(t)$  takes a value not smaller than 0.5 and not larger than 1. The second weight  $w_2^d(t)$  takes a different value that is not smaller than 0 but not larger than 0.5. The higher range of values of the first weight  $w_1^d(t)$  represent that the objective associated with the first weight  $w_1^d(t)$  is given a higher priority compared to the objective associated with the second weight  $w_2^d(t)$ . Changing the weights (e.g.,  $w_1^d(t)$  and  $w_2^d(t)$ ) within different predetermined ranges for each revolution cycle is advantageous because a number of Pareto-optimal solutions satisfying preferences can be obtained. See specification, page 15, lines 13-26.

Neither Jin nor Fonseca discloses such feature as recited in claim 11, as amended. In Jin, the weights associated with the objectives take a value in the same range. For example, both weights  $w_1^d(t) = \text{random}(\lambda)/\lambda$  (equation (5)) and  $w_2^d(t) = 1.0 - w_1^d(t)$  (equation (6)) described on

page 98 of Jin take values not smaller than 0 and not larger than 1. Likewise, both weights  $w_1(t) = |\sin(2\pi)/F|$  (equation (7)) and  $w_2(t) = 1.0 - w_1(t)$  (equation (8)) described on page 99 of Jin take values not smaller than 0 and not larger than 1. Nowhere in Jin does it disclose that different weights are allowed to change within different predetermined ranges. Therefore, Jin fails to disclose the feature of *“changing weights of the weighted sub-functions for the next cycle within predetermined ranges, a first weight of the weighted sub-functions changing within a first predetermined range, a second weight of the weighted sub-functions changing within a second predetermined range different from the first predetermined range, the first predetermined range and the second predetermined range representing preferences given to objectives of the multiple objective optimization”* as recited in claim 11, as amended.

Fonseca also fails to disclose this feature of the claimed invention. Fonseca merely states that weighting coefficient express the relative importance of the objectives. See Fonseca, page 27, left column, 31-35. Nowhere in Fonseca does it disclose that the weighting coefficient may change for each cycle, nor does it describe that different weighting coefficients may take values of different predetermined ranges. Therefore, Fonseca also fails to disclose the feature of *“changing weights of the weighted sub-functions for the next cycle within predetermined ranges, a first weight of the weighted sub-functions changing within a first predetermined range, a second weight of the weighted sub-functions changing within a second predetermined range different from the first predetermined range, the first predetermined range and the second predetermined range representing preferences given to objectives of the multiple objective optimization”* as recited in claim 11, as amended.

To establish *prima facie* obviousness of a claimed invention, all claimed limitations must be taught or suggested by the prior art. See MPEP §2143.03. None of the cited references

discloses the feature of “*changing weights of the weighted sub-functions for the next cycle within predetermined ranges, a first weight of the weighted sub-functions changing within a first predetermined range, a second weight of the weighted sub-functions changing within a second predetermined range different from the first predetermined range, the first predetermined range and the second predetermined range representing preferences given to objectives of the multiple objective optimization*” as recited in claim 11, as amended. Therefore, the deficient disclosures of Jin and Fonseca preclude the Examiner from establishing even a *prima facie* basis from which a proper determination of obviousness of claim 11 can be made. Therefore, it is respectfully submitted that independent claim 11, as amended, is patentably distinct from Jin and Fonseca.

Claims 12-18 depend from claim 11. Therefore, essentially the same arguments set forth above for claim 11 are equally applicable to claims 12-18.

Claim 20, as amended, also recite the limitation of “change weights of the weighted sub-functions for the next cycle within predetermined ranges, a first weight of the weighted sub-functions changing within a first predetermined range, a second weight of the weighted sub-functions changing within a second predetermined range different from the first predetermined range, the first predetermined range and the second predetermined range representing preferences given to objectives of the multiple objective optimization.” Therefore, essentially the same arguments set forth above for claim 11 are equally applicable to claim 20.



Based on the above amendment and arguments, Applicants respectfully submit that for at least the above reasons, pending claims 11-18 and 20, as amended, are patentably distinct from the cited references. Therefore, the Examiner is respectfully requested to withdraw the rejections based on 35 U.S.C. § 103(a).

On page 11 of the Office Action, claim 19 was rejected under 35 U.S.C. 103(a) as being unpatentable over Jin and Fonseca in view of Oyama A. et al., “Euler/Navier-Stokes Optimization of Supersonic Wing Design Based on Evolutionary Algorithm” (1999). This rejection is now moot because claim 19 is cancelled herein.

### ***Double Patenting Rejection***

On pages 3 and 4 of the Office Action, it is stated that claims 11-20 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-4, 6-7, and 14-17 of copending U.S. Patent application No. 10/007,906 in view of Fonseca et al., “Multiobjective Optimization and Multiple Constraint Handling with Evolutionary Algorithm – Part I: A Unified Formulation,” IEEE Transactions on Systems, Man, and Cybernetics (January, 1998), and also in view of Jin et al., “Adapting Weighted Aggregation for Multiobjective Evolution Strategies,” Springer-Verlag (2001).

Applicants will consider filing a terminal disclaimer for this application upon converting of the provisional double patenting rejection into a double patenting rejection after issuance of

copending U.S. Patent application No. 10/007,906 and upon indication of allowable claims in this patent application.

### ***Conclusion***

Applicants believe that all of the stated grounds of objection and rejection set forth by the Examiner in the Office Action have been properly accommodated or addressed. Applicants, therefore, respectfully request that the Examiner reconsider all presently outstanding objections and rejections and withdraw them. The Examiner is invited to telephone the undersigned representative if it is felt that an interview might be useful for any reason.

Respectfully submitted  
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